KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, MAY 26, 1882.

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OUR NEW VOLUME.

TO OUR READERS.

OUR second volume begins with No. 31, and will end with No. 60, closing therefore with the year 1882. Hereafter there will be two volumes in each year. A copious index for the present volume will be published in a few weeks.

We propose in the new volume to continue the same general plan as in Volume I. The columns for queries and replies have been closed, for the simple reason that we could not meet the wishes of the majority of our readers, in other respects, without finding room somewhere; and these columns could be best spared. A large proportion of our letters have, for a similar reason, to be omitted. The reason is as inexorable as the law that two bodies cannot occupy the same space at the same time. Some of our readers have not been willing to take this inexorable reason into account. Others compare their letters with some which have appeared, to the disadvantage of the latter, forgetting that a letter which appears may represent, not one correspondent, but a great number. If we receive ten letters on a subject, we insert the best of the ten, even though it were in some respects inferior to a single communication on another subject.

Many ask us to be more popular, and we shall bear their wishes in view; but there are limits to what we can do in that direction. Others have asked that papers should be shorter, and appear more continuously. This suggestion seems good, and we shall follow it as far as contributors will allow us. The request is really for conciseness.

In the next volume will appear the first of a most interesting series of papers by Miss Amelia B. Edwards, placing beyond dispute or cavil the identity of the Pharaoh of the Oppression. Professor Wilson's "Found Links," a series of papers having special interest just now, will be concluded early in the volume. "Nights with a Three-Inch Telescope," by F.R.A.S., Chemical Papers by Mr. Jago, Photography by Mr. Brothers, Electrical, Geological, Botanical, and Entomological papers will appear systematically. The papers on Probabilities will be brought to a close with a brief discussion of the important subject of indirect probabilities—that is, of the chances, *not* that such and such things will happen, but that, such and such things having happened, the cause was this or that. Afterwards, we shall have a series of short papers on the solution of Geometrical Problems. Whist will continue under the management of "Five of Clubs," who hopes in the next volume to complete his simple explanations of the principal rules for play. We hope (but are not justified in promising) that the skilful players of Whist among our readers (like Mr. Lewis, "Mogul," and others) will, from time to time, contribute problems, interesting positions, &c., for discussion by our Whist readers. The Chess column remains in the able hands of that skilful and courteous player, Mephisto. The chief editor has not forgotten his promise that beside problems there should be illustrative simply annotated games, and discussions of the best lines of opening. In Volume I. the Two Knights' Defence and the Giuoco Piano were fully analysed, and Mephisto hopes in Volume II. to give the analysis of other openings. It may, perhaps, interest our readers to know that three games illustrating the openings already discussed have been in progress for some time past between the Chess Editor and the Chief Editor, and will presently appear, with notes by both players (written independently). We may point with some satisfaction to the early and full news we have given of the Chess Tournament at Vienna.

Early in the new volume we hope to commence papers on "Home Cures for Poisons" (beginning with prevention as the best cure, and pointing to medical aid, as soon as possible, as essential, whatever home cures may be available), on "How to get Strong" (without training for athletic exercises), on Health Resorts, Our Food and Drinks, Cycling (Bi- and Tri-), Swimming, and other subjects wherein a little knowledge is good, and more knowledge better.

We have been strongly urged by many not to continue our effort to keep KNOWLEDGE at its present low price, but to enlarge both the price and the paper. We believe we should be justified, in a mercantile sense, in increasing our price (without enlargement of the paper) in the same proportion in which the only contemporary paper with a similar (but less popular) scope, enlarged its price soon after it was started. But as long as steady growth promises that before long, even at our present very low price, expenses will be met, we shall hearken to no such suggestions. We have wished, and we still wish, to do "our little possible" in the cause of cheap scientific literature. As long as we have our readers' support, we shall keep to this line. We remind them that, if each reader (or if, now, but one in three) were to get but one new subscriber, we could at once, and definitely, reject the suggested departure from our original plan.

SCIENCE AT THE ROYAL ACADEMY.

LET us return to the paintings, leaving the sculptures for another visit. We have also the Grosvenor Gallery to visit, and we are warned that space is limited.

Mr. Arvid M. Lindström's "Winter Landscape from Kollandsö, Sweden" (No. 45, Room I.), shows close study of nature,—not wintry details only are represented, but the general effect is caught; we seem to breathe the cold crisp air; the snow is not white wool merely, as in so many winter scenes, but cold to the touch. There is similarly close observations of nature in Mr. Rickatson's "Autumn Evening" (No. 16). Mr. John Smart's "In the Track of the Storm" (No. 69) is in many respects very fine, but in such a picture as this, which cannot possibly be painted from nature, we seldom fail

to recognise certain incongruities. Only when an artist devotes himself year after year to the study of effects observed during and after storms, training his eye (as the eye can be trained) to take in simultaneous details, and not venturing to combine effects which have not been seen in a single view, can such incongruities be avoided. Now, there are dry storms and wet storms in storm-infested regions, and though the dry storm-cloud might be mistaken by an inexperienced eye for a much-disturbed rain-cloud, there are in reality characteristic differences. The storm-cloud in Mr. Smart's painting is a wet one; the storm-track is dry, although the wet storm-cloud has but just passed over it. Once more; it is manifest that the painter did not make the storm-track a study immediately or soon after the storm, but some considerable time afterwards. For the most striking feature of a storm-track, immediately after the storm is over, is the staring effect of the rent wood where boughs have been torn off. Whether the wood be white, or yellow, or red, the torn and ragged wood looks intensely bright by contrast with the foliage, or with the dark and time-worn bark. In Mr. Smart's picture this effect is not seen; on the contrary, the broken surface of the wood is shown with such tints as only come after a few weeks', or at least several days', exposure to wind and weather. Apart from this incongruity, and regarding the picture as representing a rainless storm passing over the track of a former storm, the painting is a very fine one, the only fault being that Mr. Smart has either not caught the peculiarities of the dry storm-cloud, or that, intending to represent the storm-cloud which comes accompanied by heavy rain showers, he has not duly represented the effect of such showers in the immediate track of the storm.

In Mr. Graham's "Inflowing Tide" (No. 77, Gallery I.), the sky seems to us unnatural, but the wild effect is well given.

As it is the business of science to try to discover the real nature of things mysterious and perplexing, we have endeavoured to find the true answer to Mr. Henry Vincent's "What is it?" (No. 87). At present, the answer which comes to us is "An exceedingly bad picture"; we should have thought it a school-girl's early attempt, touched here and there by a much-wearied master. The real mystery is "how got the picture in?" Near by is a "Monk of the Order of St. Francis," by Tremayne Lark (No. 88). For some reason the monk is anxious to suggest the idea that he is reading hard; but he is a very bad actor.

We have already referred to one of Mr. Brett's contributions this year—the larger. Of that picture we may simply add, that after the best part of a life passed near the sea, and with special opportunities for studying Cornish sea-scapes, we have never seen a rich blue sea in "the grey of the morning;" and we should be surprised to hear that any one else had: it seems a meteorological impossibility. Of his smaller and, in our opinion, much better painting, "A Falling Barometer" (No. 128), we may note that there is probable incongruity between the heavy, broken sky in one part of the picture and the wine-tinted sea in another. A similar objection applies to Miss Jane Inglis's pleasing picture, "On the North-west Coast of Cornwall" (No. 421, Gallery IV.). But occasionally such combinations are seen. Whether it is wise, or artistically sound, to combine them in a painting, may be questioned. But unfortunately the kind of sky which Mr. Brett paints best, and the kind of sea with which he seems most familiar, are not ordinarily seen together. We note in the smaller, as in the larger painting, that the sea is not level. Under broken lights, we are aware, the surface of the sea often presents a singularly illusive effect of unevenness; but Mr. Brett, in "A Falling Barometer," has done something more than to suggest this peculiar illusion.

In No. 182, "Bargaining for an Old Master," Mr. Henry Woods shows marvellous skill in representing pots and pans. (*Punch* has admirably, and as it were lovingly caught the Punch-like aspect of the principle figure). The Dutch school often introduce pots and pans with great effect; but we know of no painting in existence where there are so many pots and pans, drawn and painted with such exceeding care as in Mr. Wood's picture. They are so well depicted, that the painting ought to find a place in M. Mirobolant's *cuisine*—no one with higher artistic tastes could stand all these culinary utensils, we should imagine; but M. Mirobolant might like them, or even, like the celebrated M. Cavalcadour, "require eight more stew-pans, a couple of braising-pans, eight sauté-pans, six bain-marie-pans, a freezing-pot with accessories, and a few more articles of which I will inscribe the names."

The "Raven Crag," by Joseph Knight (No. 192, Gallery II.), is excellent, thoroughly true to nature from sky to foreground.

In Gallery III. we notice as a singularly fine painting, in which a transient effect is very perfectly represented, Mr. Maurice Page's "Startled" (No. 210). The painting of the startled wild ducks reminds us of Melchior Hondekoeter, but the landscape is better than any of the Dutchman's.

We have already touched upon the incorrect perspective in Mr. Marcus Stone's "Bad News." There is a more serious fault in the expressions of the three faces, which suggest anything but what, we conceive, Mr. Stone wished to represent. For instance, we suppose he did not intend the trooper to look as though he thought, "*This*, I suppose, is the kind of face I should wear till she looks round." But that is exactly how he does look. All three faces wear manifestly assumed expressions.

One of the most charming pictures in the Exhibition is No. 378, Mr. Noble's "Toilers of the Road." The contented look of the animals as they enjoy the cool water in the trough, is admirably true to nature. The donkey is "too sweet for anything," as school-girls say. Some have complained that this picture is hung so high. It is seen best at a distance; but, considering the subject, should have been put lower down.

Mr. John Piggott's "Dread Winter" (No. 387, Gallery IV.) is excellent; but the wintry effect does not go beyond bitterness. The name, "Dread Winter," is suggestive of something more appalling than anything shown in Mr. Piggott's capital picture.

No. 413, Gallery IV., "Inverlochty Castle and Ben Nevis," by Mr. Keeley Halswelle, is admirable, but the clearness with which the Castle in the midground is shown is inconsistent with the aerial perspective. No. 414, "Trimming the Net," by Mr. David Farquharson, is a charming picture, the sky especially true to nature.

Mr. Otto Scholderer, in his "Fine Yarmouth," No. 415, has successfully mastered the difficulty of representing the tint and appearance of dead fish,—so successfully as to suggest serious regret that the difficulty is not greater. If it were but impossible to paint such disgusting subjects! In Mr. J. T. Linnell's "Wild Flowers, No. 419, on the other hand, a very pretty natural effect has been exaggerated, and extended over too wide an area.

Mr. Hermann Smith is writing for *Musical Opinion and Music Trade Review* a series of papers entitled "In the Organ and in the Orchestra," in the course of which many new ideas bearing on the production and appreciation of musical sounds are put forth, and several old beliefs are viewed from new standpoints.

THE TOTAL ECLIPSE.

THE accounts hitherto received give very imperfect ideas as to what has been done, and the telegrams seem to have been despatched with careful instructions to leave entirely unnoticed whatever has been done by some of the most important members of the observing force. We hope next week to have letters from the scientific seat of war. In the meantime, we note that MM. Thollon and Trépied have determined the exact place of the bright line in the spectrum of the corona identified with 1474 of Kirchhoff's scale. Tacchini and Thollon could see no dark lines in the spectrum of the corona, using different dispersions, so that one or other might be expected to have seen such lines if on this occasion (as in the last Indian eclipse) they had been visible. Lines of hydrogen, and many bright lines seen in the spectrum of the corona, were studied by Thollon. The absorption lines observed in Group B (atmospheric) were observed by Trépied and Thollon to be stronger near the moon's edge, which has been described in the telegrams as "indicating a lunar atmosphere." It seems to us rather to indicate the weakening of the sky spectrum there. Considering how many spectra of stars have been observed by Huggins close to the moon's edge without change in the strength of the absorption lines, it would require something more than the comparatively rough observations possible during eclipse to indicate a lunar atmosphere, whether such atmosphere exists or not. Good photographs were taken (we trust Mr. Ranyard met with good success in this direction), and in these *a fine comet close by the sun* is well shown. Let us hope it is not the "*Spectator's* comet." More of this anon.

THE AMATEUR ELECTRICIAN.

ELECTRIC GENERATORS (*Continued*).

IT is probable that some of our readers, in making a machine, will experience some little difficulty in getting a current from it, unless the very greatest care is taken to ensure the perfect insulation of the wire. It would make the machine much more reliable, if before winding the wire, a layer of paper thinly-coated with shellac varnish is fitted and fixed on to the coil of the armature. The wire,

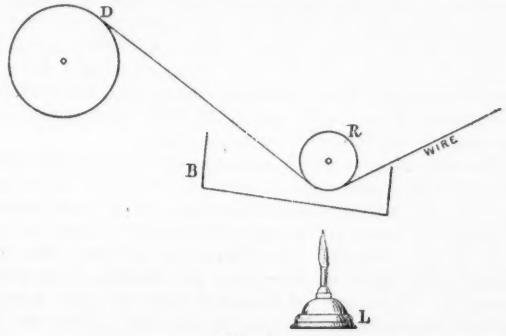


Fig. 4.

too, might with advantage be passed slowly through a little melted paraffin wax, and so be covered with an insulator of the highest quality. This may be very easily accomplished. Fig. 4 will illustrate the arrangement. (D) is the bobbin of wire (as it is received from the manufacturers), and capable of revolving on a horizontal pin formed by driving a pointed piece of stout wire into the side of a common box, or any suitable article. (B) is a small tin box, such as a one-pound biscuit-box, containing the paraffin wax (say half-a-pound), and a small reel (R) to revolve on an axle formed by fastening a piece of stout wire into the sides of the box. A spirit-lamp or Bunsen gas-burner (L) is placed under the tin box (B), to keep the wax in a thoroughly liquid state, but not sufficiently hot to produce any considerable amount of evaporation. The armature-coil, or whatever else we may wish to cover with wire, may be easily attached to a spindle, so that, by turning it round, we can at the same time pull the wire from the bobbin (B) under the reel (R), and by using the left hand (or the right, if more convenient) as a guide, the layers of wire may be made very regular and compact.*

Those who have the necessary convenience are strongly recommended to measure the resistance of the coil of wire. Our armature should contain about 7 lb. of No. 24 wire offering a resistance of 6·9 or 7 ohms. The chief danger is that of the wire coming into contact with the iron. This is a fault which may be easily detected by using a battery cell with a galvanometer, such as the one described in our first article, in circuit. Take the two wires (one from the galvanometer, and the other from one pole of the battery); connect one to one end of the armature-coil, and hold the other on to the iron itself. If a deflection is obtained, it is clear that a current is passing—that is to say, the wire is bared somewhere, and is touching or making contact with the iron.

Before considering the armature as finished, we must decide on and arrange our "commutator," or current reverser. On to the plain gun-metal cap drive a boxwood or ebony ring† or cylinder half-an-inch long, tight enough to prevent it slipping, and on to this fix by small screws a brass cylinder cut longitudinally into four sections, so that we shall have four pieces of metal represented in section by A B C D (fig. 5); then join one end of the coil of wire to A and the other to B.

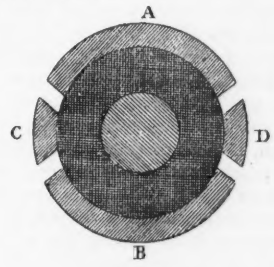


Fig. 5.

Now for the "inductor." In very small machines the magneto principle is preferable to what we have yet to describe as the dynamical. In a purely magneto machine, the currents of electricity obtained from the revolving armature are generated by the inducing force of permanent steel magnets. These should be very strong, each capable of supporting, under the most favourable circumstances, at least 7·5 times their own weight. The Jamin magnet‡ (a Parisian manufacture) is capable of sustaining fifteen times its

* Another method of paraffining is to heat some of the wax in a porcelain evaporating dish, and pass the wire through a loop made in a piece of glass rod, dipping below the surface of the wax.

† These substances are recommended where there is any difficulty in procuring ebonite.

‡ This is simply a compound magnet composed of a number of strips of very thin steel placed one over the other, the surfaces being coated with varnish.

weight, but it is feared that they are too costly for the average amateur. There are, however, several good makers in England, such as Theiler, Blakey, and others, whose magnets may be relied upon to support nine or ten times their weight. Here it would not be out of place to mention that the magnetisation of a piece of steel or iron depends, not so much on the strength of the inducing magnet, as on its own "saturation point" or its magnetic capacity. The purer the iron the higher is its saturation point, but this is obtained at the expense of its power of retention, that is to say, pure iron cannot become a permanent magnet, although it may be temporarily raised to a higher state of magnetisation than a piece of steel or iron containing a very small proportion of certain foreign substances (carbon, &c.).

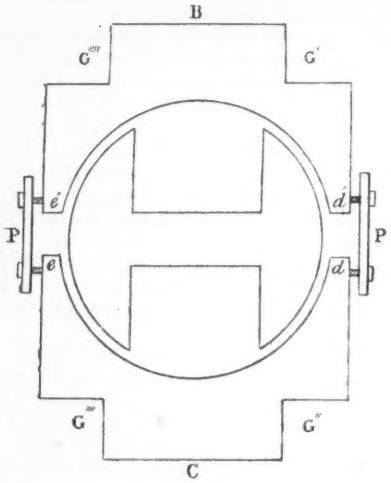


Fig. 6.

Fig. 6 is a vertical section of the "pole-pieces" of our magnets. B and C are two pieces of cast iron (softness not essential, because of their being closely attached to, and always actuated by, permanent magnets), each piece being 4 inches long. They should be cast with a semi-circular cavity, the two parts temporarily clamped and carefully bored out to a diameter of about $1\frac{5}{8}$ or $1\frac{3}{4}$ inches, just large enough, in fact, to allow the armature to revolve freely without touching. The edges ($e\,e'$, $d\,d'$), should be filed down about an eighth of an inch, brass plates (p and p'), having been previously fitted and tapped, ready for screwing on to the pole-pieces, to render the combination compact. G′, G″, G‴, G⁗ are grooves, into which the magnets are to be fitted, and should be just deep enough to make the top and bottom of the pole-pieces flush with the magnets.

Having secured the pole-pieces, the magnets should be fixed. They should be of the U form, but not too broad, a number of narrow ones put side by side giving much better results. Referring to fig. 6, put all the north poles in G′ and G⁗, and all the south poles in G″ and G‴. To fix them on, place small brass washers top and bottom across the opening between each pair of magnets, and pinch them together by small brass bolts and nuts. We should recommend our readers to make their own magnets if they possibly can, providing also that they can procure sufficiently good steel. The steel should be in strips about a quarter of an inch thick, half to three-quarters of an inch wide, and 9 inches long, bent so as to measure $1\frac{3}{4}$ to 2 inches between the legs of the U. The best way to magnetise a strip, after it has been brought to the desired shape, is to put coils of wire over the legs (in such a way as to form a continuous coil), and pass a current of electricity through the wire for a minute or so, breaking the circuit two or three times during the operation. The magnets should be fitted as close together as the bolts above referred to will permit, but not touching, and should as nearly as possible fill up the length of the pole-pieces. If any difficulty is experienced in this matter, Messrs. Blakey, Emmott, & Co. (Halifax), will supply magnets ready to attach to the pole-pieces at 1s. 6d. each. Ten of these would be required, that is, five on each side. There is a little more to be said, which we must, however, defer till next week.

THE COLD WEEK IN MAY.

THERE is something startling in the placid way in which M. de Fonvielle advanced, as we have seen, the asteroidal theory of the cold week in May is presented. It was never held, even by Ertel, who first advanced it, to be anything beyond a probable surmise, nor has it at any time been adopted by astronomers of standing. But, in reality, the supposed fact on which Ertel originally based the theory, the only circumstance which gave to the theory an appearance of plausibility, has been shown to be no fact at all. It was formerly supposed that the stream of small bodies, to which we owe the meteor shower commonly seen on November 13-14, is nearly circular in shape. Now, one of the points where this stream crosses the level of the earth's track corresponds with the place occupied by the earth on November 13. Half a year elapses between midnight, Nov. 13-14, and May 15, noon; but, owing to the earth's more rapid motion in winter than in summer, she crosses just opposite the place she had held on Nov. 13-14 at midnight, on May 12 about noon. Ertel reasoned that, assuming the November meteors to form a zone of small bodies around the sun, the zone being less in extent than the earth's orbit, this zone must of necessity cross the level of the earth's orbit at a point directly opposite the place of our November encounter with them, and lying inside the earth's track, or between us and the sun. The zone of meteors would therefore intercept a portion of the sun's heat on or about May 11, 12, and 13. The August meteors would, in a similar way, account for the cold spell of February. And though the April "borrowing days" could not be explained by a meteor system giving October displays (for there is no such system), yet the theory was not therefore invalidated. For, of course, a meteor system may lie between our earth and the sun at one part of the earth's annual course without necessarily crossing that course itself at its opposite point. Thus it seemed as though there were very strong positive evidence in favour of Ertel's explanation of these cold snaps, and no negative evidence of weight against it.

This reasoning is often quoted at the present day, when all its weight has departed from it. We now know very certainly that neither the November nor the August meteor systems pass between the earth's track and the sun on any part of their circuit. The November meteors cross the earth's track itself at the point she reaches on or about November 13-14, and of necessity they cross the level of her track again at a point exactly opposite, or lying in the same direction from the sun as the earth does on or about May 12. But, instead of this second place of crossing lying between the earth and the sun, it lies far away in the remote regions of the solar system, near the track of the planet Uranus, or about twice as far from the sun as Saturn, the remotest of all the planets known to ancient astronomers. In fact, it is believed that we owe to the

planet Uranus the introduction of the November meteor zone into our solar system, either through a close approach of that giant planet to the meteor family at that point of its track where it still approaches the path of Uranus, or else from the actual expulsion of meteoric fragments from the interior of Uranus millions of ages ago, when the planet was passing through its sun-like stage. Be this as it may, it is certain that the November meteor system—though at the very time when these words were written it lay in the same direction from the sun as our earth does—yet lies some nineteen times as far away, or, roughly, about 1,650 millions of miles further from the sun than we are at this present time. To charge the November meteor system, therefore, with robbing our earth of a portion of its supplies of solar heat is to imitate the wolf in the fable, who accused the lamb of troubling the stream, though the stream flowed from the wolf towards the lamb. The sun's rays in May pass our earth on their way to the November meteor system, not that system on their way to the earth. It is, therefore, now a matter of scientific certainty that the cold snap in May is not caused by the November meteor system. As for the August meteors, their track has been found to be even far wider, and in February, when Ertel supposed they were intercepting our supplies of solar heat, they lie forty times farther from the sun than our earth.

It does not of necessity follow that Ertel's theory is erroneous; but now that the evidence he seemed to find in its favour from the November and August meteors has been shown to be fallacious, the defects which from the first characterised the theory will be more readily admitted. These are sufficiently manifest. If meteors diminished our supply of heat, it could only be by coming actually between the earth and the sun in such a way that they could be actually visible (if sufficiently magnified with a telescope) upon the sun's face. If they formed a fine cloud of cosmical dust, they would reduce his apparent brightness in a measurable degree if they affected in such degree the supply of heat we received from him; and this has never been noticed. If they were individually large enough to reduce the supply of heat, they ought to be individually visible as black objects crossing his face even to the naked eye, but certainly with powerful telescopes. No such bodies have ever been seen.

However, there is a terrestrial test for the theory by which its validity could be readily determined. If meteoric bodies come between the earth and the sun at any time in such numbers as to make us feel cold in their shadow, they cool the whole earth, not England, or Europe, or the northern hemisphere. If, then, on a careful comparison of the mean daily temperature at observatories all over the world, it is found that the cold snaps of February, April, and May are everywhere to be recognised, then it must be admitted, at least, that the cause of the peculiarity is to be sought outside the earth herself. If, on the contrary—as, for my own part, I suspect would prove to be the case—no trace of these cold snaps could be recognised—say, in Australia and South Africa, though cold snaps at other dates might be noticed—then the peculiarity must be regarded as local. It may extend over the British Isles, or even the whole of Europe, or it may even, though this seems unlikely, prevail over much larger portions of the northern hemisphere; but if not recognised (and that, too, at precisely the same epochs) in both hemispheres, its cause cannot be regarded as extra-terrestrial. It should not be difficult, if the cause is on our earth, to trace it to its source. I should not be surprised if that source were found to lie among the ice-fields of the North Atlantic.

PHOTOGRAPHY FOR AMATEURS.

By A. Brothers, F.R.A.S.

PART VIII.

LANDSCAPE photography, portraiture, copying, and various other branches of photography may be followed by the amateur after he has mastered the working details given in previous papers. But there is one branch to which many readers of KNOWLEDGE will naturally turn their attention as soon as they can manipulate a collodion plate. Astronomical photography is one of the most fascinating sections of the art-science, and it is one in which it is not difficult to achieve success, always supposing that a good telescope is available. The method of procedure is the same whether the telescope be of the refracting or reflecting form. With a reflecting telescope, there is no difficulty with the actinic focus; but with a refractor, allowance has to be made in a way presently to be referred to. We will describe the apparatus necessary to attach the plate-holder to a refractor. The eye-piece must be removed, and in its place a piece of tubing of the same diameter must be provided. To this tube a piece of flat brass plate must be attached, and the dark slide of the camera may be arranged so that it will slide on to the brass plate and remain secure in any position of the telescope. No camera is required—merely the means of holding the prepared plate. On a plate $4\frac{1}{4}$ by $3\frac{1}{4}$, two pictures of the moon may be taken, merely by shifting the slide about one diameter of the moon, after making the first exposure. With a slightly-varied arrangement of the brass plate and dark slide, four exposures can be made on the same plate. With telescopes up to 6 ft. focal length, the size of plate named will be sufficient; but with larger instruments, a plate 5 by 4, or $6\frac{1}{2}$ by $4\frac{3}{4}$, would be preferable.

The preparation of the plate is just the same as for a landscape or copy. In order to find the focus, a piece of ground glass may be placed in the dark slide, with the ground surface towards the object, and the image of the moon may be brought into sharp visual focus. The focussing tube of the telescope having been drawn out so as to allow some "play" for finding the actinic focus, a slight scratch should be made on the tube to show the point of visual focus, the sensitive plate may be put into the slide and the shutter withdrawn. The cap of the telescope should be removed, and a cover of some opaque material substituted, and made to fit loosely, so that, in making the exposure, the telescope should not be disturbed. The driving clock having been adjusted to the moon's motion, which can only be done approximately, the object glass covered, and the prepared plate in its place, the temporary cap may be carefully removed, and held a short distance off, so as to allow any vibration of the telescope to subside, and the exposure may then be made. The time of exposure must be varied according to the phase of the moon, the focal length of the telescope, and the state of the atmosphere. At the time of full moon, and if the sky be very clear, the time of exposure may be one second or less—experiment alone will determine this point. The first image taken in the visual focus is sure to be indistinct; and now, to find the actinic focus, turn the focussing tube *outwards*—say one-eighth of an inch—and then take another picture, taking care that the slide has been moved forward; at the same time, a mark must be made on the brass tube. Proceed thus, carefully noting the improved sharpness of the image. It is obvious that, if the second picture is less distinct than the first, the plate must be placed nearer to the object-glass. The focus is longer or shorter, according as the object-glass is over or under corrected.

XUM

An expenditure of much patience may be necessary before satisfactory negatives of the moon will be obtained, but as soon as the actinic focus has been found approximately, the work on each evening will be more easy; but one or two trials must be made to test the focus, which will vary with the temperature, owing to the alteration of the length of the telescope tube.

In order to show the effect of atmospheric disturbance, a photograph of any bright star may be made—Sirius, for instance. Put the plate in position, and then, the telescope being at rest, allow the image of the star to pass across the sensitive film; on development, it will be found that, instead of a straight line, it will be of zig-zag form. This atmospheric disturbance, of course, affects the picture of the moon, and it is not easy to distinguish between this defect and the incorrect focus. It may be necessary to take dozens of negatives in order to secure one good one. For this reason, there is a great saving of time if the plate be arranged so that four pictures can be taken successively, the times of exposure being varied.

In a future paper, the gelatine dry plate process will be described. This process is very much more rapid than wet collodion, and it may be thought that, for that reason, it should be preferred for astronomical photography; but up to the present time the best photographs of the moon have been taken by the wet process, and so far as my own experience extends, the dry gelatine plate is not so suitable for enlarging—much of the finer detail of the original negative is lost in enlarging by either process, and there can be no doubt that the long-neglected Daguerreotype plate would give better results than any of the more modern processes.

It will be necessary to examine each negative with a lens, in order to judge whether sufficient sharpness of detail has been obtained, selecting the craters near the terminator of the moon as tests.

One of the most curious and interesting results of the application of photography to astronomical observation is in the combination of two pictures of the full moon to be viewed in the stereoscope. By selecting negatives that have been taken in suitable states of the libration of the moon, and by mounting transparencies (in preference to paper), enlarged to the same size, we obtain a picture showing the rotundity of the moon in a very remarkable way.

The diameter of the images of the planets in telescopes of moderate size is so small, that no results of any value can be obtained.

The great value of photography, as applied astronomically, has been in determining, first, that the red flames seen during total eclipses of the sun really belonged to the sun; and, more recently, the much-disputed question as to the solar corona was finally disposed of by comparing photographs taken at stations widely separated.

Reviews.

PROF. HUXLEY ON SCIENCE AND CULTURE.*

LIKE others of the most valuable works by Prof. Huxley, the book before us is a contribution rather to literature than to science, though the author derives some of his most effective arguments and illustrations from science. The Essays, Lectures, and Addresses which form the volume are gathered from various magazines in which they have appeared at intervals during seven or eight past years. Some critics (mostly those who, being themselves essayists, can find none to publish volumes of their collected papers) take strong exception to the course thus pursued by Prof. Huxley. Such a critic, in reviewing a volume of essays by the present writer, said that to collect and republish essays which have already appeared was the worst possible offence; and another compared the author of such a volume to a highwayman holding a pistol in the form of an octavo volume at the head of an unoffending public. The answer is obvious. If the public does not like such works, the public can and does leave them alone; but if the public finds an author's republished essays worth re-reading, the author is something more than justified in republishing them. It appears—who, indeed, could doubt it?—that Professor Huxley's readers are of this opinion. "I can give no better reason for republishing [these papers] in their present form," he says, "than the fact that three earlier collections of a similar form have been received with favour." And a very sound and sufficient reason it is.

The first paper—an address on science and culture—is interesting for the strong, yet moderate, assertion of Prof. Huxley's claim for pure science as a necessary part of culture. He rejects, on the one hand, the arguments of self-styled practical men (expressing in passing a belief, in which we wish we could share, that "the pure species has been extirpated"), and, on the other, those of certain classical scholars, who consider themselves, as it were, Levites in charge of the ark of culture. He shows very clearly the distinction between the mere Latinism of the Middle Ages and the true classical culture of the Renascence. He pokes a very clever joke at the advocates of merely scholastic training, where he says that "if we were disposed to be cruel, we might urge that they have brought reproach upon themselves, not because they are too full of the spirit of the ancients, but because they lack it." "Modern astronomy," he says justly, "is the natural continuation and development of the work of Hipparchus and of Ptolemy; modern physics of that of Democritus and of Archimedes; it was long before modern biological science outgrew the knowledge bequeathed to us by Aristotle, by Theophrastus, and by Galen." "We cannot know all the best thoughts and sayings of the Greeks unless we know what they said about natural phenomena. We falsely pretend to be the inheritors of their culture, unless we are penetrated, as the best minds among them were, with an unhesitating faith that the free employment of reason, in accordance with scientific method, is the sole method of reaching truth." This lesson from the ancients is, indeed, the key note of the first six of the Addresses, Lectures, and Essays gathered together in the present volume. Scattered through these essays there are numbers of pithy sayings, well worth quoting and remembering. Here are a few of them:—"An exclusively scientific training will bring about a mental twist, as surely as an exclusively literary training." "Knowledge is only the servitor of wisdom" (may this, our KNOWLEDGE, be so regarded!) "Do what you can to do what you ought, and leave hoping and fearing alone." "The assertion which outstrips evidence is not only a blunder but a crime." "The Nemesis of all reformers is finality." "When you cannot prove that people are wrong, but only that they are absurd, the best course is to let them alone." (Note that, Mr. Editor of KNOWLEDGE!)

The other essays are more specially scientific. In them Professor Huxley deals with the Border Territory between the Animal and Vegetable Kingdoms. Certain Errors respecting the Structure of the Heart,

* "Science and Culture, and other Essays." By T. H. Huxley, LL.D., F.R.S. (Messrs. Macmillan & Co., London.)

attributed to Aristotle, the Hypothesis that animals are automata (a most interesting essay), Sensation, Evolution in Biology, "The Origin of Species" (an essay of somewhat melancholy interest just now), and the connection of the biological sciences with medicine. In all these essays Professor Huxley shows the love of truth, the plainness of speech, the strong common sense, which characterise all his writings, while his profound knowledge of those matters whereon he speaks as one having authority, and not as a (mere) scribe, gives to these writings a scientific value altogether apart from their personal and literary qualities. Every one who wishes to be on a level with the scientific thought of the day must read this work.

SOLAR ENERGY.

BY DR. SIEMENS.

WHEN communicating to the Royal Society, on March 2, my speculation on the conservation of solar energy, I was aware that I might, perhaps, give displeasure to those who strongly adhere to what may be called text-book information on the subject; I cannot, therefore, feel surprised that Mr. Proctor refuses to accept either my explanation or the mathematical proof by which I endeavoured to establish the fundamental condition of my theory that of solar fan-like action in a space filled indefinitely with attenuated matter. I am bound to admit that in replying (necessarily somewhat hurriedly) to Mr. Archibald's letter in *Nature*, I used the word "moment" where "force" might have been more correctly employed, but with this exception I fully maintain my mathematical statement of the problem.

It is by no means necessary, as maintained by Mr. Proctor in the *Cornhill Magazine* article, that centrifugal force, acting upon the circulating matter, should balance the force of solar gravitation upon the same; it is in effect less than the thousandth part; and yet continuous equatorial outflow must take place. Astronomers have hitherto regarded the atmosphere surrounding a heavenly body as taking part wholly in its rotatory motion, in which case the only effect produced by rotation will be ellipticity, or a permanent rise of the atmospheric column in the equatorial regions unaccompanied by continuous motion. The fundamental difference in my assumption is the surrounding matter indefinitely extended into space, which cannot be supposed to take part in the rotatory movement of the gaseous matter in immediate contact with the rotating ellipsoid. In this case there is no elliptic atmosphere to be maintained in balance by its greater depth in the equatorial regions, and the tendency to rise to a greater height in that direction in order to attain a statical balance, can only result in equatorial motion, or in the circulating current, which I make the basis of my hypothesis.

It would be idle to attempt further argument on this subject; but solar eclipse observations must before long decide the question either in favour of Mr. Proctor or myself. C. W. SIEMENS.

[It is singular to find a man of Dr. Siemens' calibre, when possessed by a paradox (which has happened to Galileo and Kepler and Newton) adopting the tone of our Hampdens, Croslands, and their like, who have always "been *told* that there would be strong opposition to their views." I must confess, too, I am rather amused to find that I, of all men, should be regarded as "strongly adhering to text book science," who have been held utterly wanting in respect for mere authority. On this very subject about which Dr. Siemens has advanced these new views, I have done at least as much as any living writer to dispossess long established ideas,—*only*, having based my views (1) on sound and sufficient knowledge of what had been already done, and (2) on mathematical reasoning, I have seen them, after rather obstinate contest, take their place among accepted truths. Dr. Siemens will find that I was the first to assert, as demonstrably established, the configuration of the solar corona which his theory requires, and which actually exists (though it does not prove his theory), at a time when such men as Sir John Herschel (grand old man) and Sir George Airy held the terrestrial theory of the corona to be admissible.* Apart from what I have endeavoured to establish, myself, with more or less success, outside of text-book astronomy, I have always shown readiness to accept the extra-text-book science of others—where it really is science. If, then, I do not accept Dr. Siemens' explanation, it is because I hold it to be entirely unscientific—though Dr. Siemens is a man of science, and one of well-deserved reputation in his own departments. If I reject what Dr. Siemens calls the mathematical proof of the fundamental conditions of his theory, it is because there is nothing mathematical about it. Apart from the mistake (in one sense quite insignificant, in the other exceedingly significant) in the use of a familiar expression, the so-called proof proves nothing: *it is the mere beginning of a statement of certain impossible conditions.*

The question whether or not the atmosphere of a heavenly body extends indefinitely into space, its outer parts not sharing the rotation of the planet, has no real bearing on Dr. Siemens' views. So far from hitherto regarding the atmosphere as wholly sharing in the rotatory motion, I consider it far more likely that the rotating atmosphere merges into the general atmosphere of space. But the laws of motion remain. A gaseous mass, wherever it may be, is urged sunwards by the sun, and can only fail to tend sunwards when his attraction is counterbalanced by the attraction of some other heavenly body. The tendency, when not thus counterbalanced, may not lead to motion sunwards, because it may be balanced by centrifugal tendency or by elastic forces; but these elastic forces are generated by the solar attraction, and cannot possibly generate constant efflux from him. There is no difference between a cubic foot of gaseous matter opposite the sun's equator but outside his rotating atmosphere, and an equatorial cubic foot of such matter within his atmosphere, so far as the nature of the forces at work is concerned, *except* that the former, having less rotational motion, has relatively less centrifugal tendency. The best Dr. Siemens could do for his theory would be to have all the rotational movement of the sun at work to produce recession—and that would not suffice; yet he makes it a strong point of his reasoning that the gaseous matter which he wants to be continually receding, cannot be supposed to take part in the rotatory motion of the gaseous matter in immediate contact with the rotating ellipsoid.

It would indeed be "idle to attempt further argument on this subject," if the first principles of hydrodynamics are set on one side in the attempt to establish Dr. Siemens' paradox—for paradox it unquestionably is. But eclipse observations will not help to make the matter clearer. The appearance presented by the corona would be practically the same, whether the movements imagined by Dr. Siemens took place, or those movements of cosmical dust, under the action of gravity, which astronomers recognise.

I note that Dr. Siemens does not consider *at all* the equally decisive disproof of his theory (as a sufficient explanation of solar and stellar work) afforded by the shining of the fixed stars. We know that if there is no utilisation of star rays in space, Arcturus and Aldebaran are suns pouring out second by second much more light and presumably much more heat than our sun; Sirius pours out at least 200 times as much; and on the average, every star we see, and every star brought into view by the most powerful telescope, is a rival of ours. If their rays *are* utilised, those stars are, on the average, very much larger than our sun, and only so much is wasted as we can measure—that is, *still*, many millions of millions

* Singularly enough, I had barely laid down my pen after writing my reply to Dr. Siemens, when I read in *Nature* a passage forming a strange commentary on the above remarks. When in 1869 I showed, by mathematical reasoning (which Sir John Hershel and Sir G. Airy both, in letters to me, admitted to be sound and sufficient—as they were, of course, to any mathematician), Mr. Lockyer, of whom it was jestingly said a few months later, that "he called himself owner of half the corona," remarked in *Nature* that it was absurd of me to express an opinion where "even the workers" (meaning himself, I think), could not decide. Though he did decide; for having started a theory of the sun with which the great extension of the corona was inconsistent, he insisted very positively that the corona is, in the main, a terrestrial phenomenon. I was content to wait; but pointed out observations by which the real nature of the corona might be shown (to those who could not follow the mathematical proof), and others by which Mr. Lockyer's more general theory of the solar atmosphere could be disproved. These observations, as it chanced, were made during the next eclipse (the latter by Professor Young). Little by little "the workers," meaning Mr. Lockyer, had to yield more and more of the corona to the sun, until now we find in *Nature*, Professor Newcomb's picture of a corona extending many million miles from the sun, described by Mr. Lockyer as certainly representing a solar appendage. But the amusing thing is, that though Mr. Lockyer's theories are dead, "still in their ashes burn their wonted fires." He thus describes in the *Daily News* the state of scientific opinion which differs so diametrically from what was once his own:—"Certain and sure evidence was obtained that the outer atmosphere extends much further from the sun than had been previously supposed *by those most competent to form a just opinion.*" I would submit that to have formed and maintained for years a wrong opinion is not proof positive of superior ability to form a right one

of times as much energy as our sun pours on all the planets. The difficulty, or rather the mystery, underlying the constant emission of so much wasted light and heat is not removed, unless we are to assume that the distance between the stars and our sun is not sufficient for the utilisation of more than a part, possibly a very small part, of a sun's energy. But even if this were admitted as reasonable, instead of being rejected as obviously the reverse, who that recognises the vastness of the interstellar spaces or knows how many millions of years would be required to draw matter from midstellar space to the neighbourhood of even the nearest sun, can for a moment suppose that the matter thus prepared can be used up as Dr. Siemens' theory requires? What matters it, so far as this mystery of mysteries, the mystery of infinite energy seemingly wasted, is concerned, whether solar and stellar rays of light and heat are directly lost (*to our universe*) as they are radiated through interstellar space, or whether they are constantly employed in modifying matter which can never by any chance come (in time to be of use) to *any* star in space?

Considering that the forces conceived by Dr. Siemens have, in the first place, no existence, so that the mechanism of his "perpetual round" could never even be started; that, secondly, the work supposed by him to be done in interstellar and interplanetary space is certainly not done (or the stars would not shine as they do); and that, thirdly, if the work were done there it would be altogether worthless, I venture to say that Dr. Siemens' theory is absolutely inadmissible. If it be asked why, that being so, the mathematicians of the Royal Society invited Dr. Siemens to read his paper, I can only suggest that this was but a just and proper tribute to the excellent scientific work for which he is, and will always remain, deservedly eminent. Richard A. Proctor.]

BUTTERFLIES AND MOTHS.

As the month goes on, both moths and butterflies are becoming more and more plentiful, both in regard to the number of individuals and the species to be obtained.

During the week just passed we have had over twenty moths emerge from the pupa, the larva or caterpillars of which we bred last year.

This breeding is the best means of getting a good collection, as the insects come fresh and undamaged from the chrysalis, whilst those caught by any other method whatever are sure to sustain some breakage or other damage, and we advise collectors to take all caterpillars they can find, and breed them up. Some difficulty may be experienced at first as to food, but by taking notice from what trees the caterpillars are taken, and feeding with the same, the difficulty is overcome.

In redemption of one of our last week's promises, we now give the most commonly-employed methods for catching butterflies and moths. For butterflies the only way is to have a net, various forms of which are in use, the clap-net, and oval or round sweeping-net being most common. The clap-net is a rectangular piece of gauze with a rod at each side, which latter are used as handles. To capture an insect with this the net is thrown over it, and the side-rods or handles rapidly brought together. This action encompasses the victim in the folds of the net, where he is killed and transferred to the pocket-box.

The sweeping-net is a deep bag of the same material as the last, the mouth being kept open by a piece of cane or thick wire bent to the form of an oval or circle. The net should be about 3 ft. in depth by 1 ft. across the top, and tapering to a point at the bottom, this size being the most convenient, anything much larger proving too clumsy in use. Personally we prefer this form to the clap-net, though first-class work can be done with either with a little practice.

Whilst hunting butterflies, one rule must be observed, *never get between the sun and the insect*, as your shadow will nearly always prove fatal to the chance of capture; also, try to get to windward, if possible.

As moths fly principally in the night-time, very different methods to the above must be adopted. Sugaring is that most generally in use. It consists in smearing the trunks of trees in woods, forests, &c., with a composition formed of beer and sugar boiled together, with sufficient new rum added when cold, to give it a strong smell, and to increase its intoxicating properties. The moths come to it in great numbers, and becoming quite stupefied with the rum, can be easily taken in the chip-boxes mentioned in last article. When sugaring, a good lantern, preferably a bull's-eye, is indispensable to show up the moths in the dark. The hour to begin sugaring depends on the state of the weather, &c., but, generally speaking, as soon as it becomes tolerably dark it is time to start. A still, warm night will be sure to supply plenty of game, but if there is any East in the wind, or a bright shining moon, scarcely a moth will be seen.

Numerous other ways have been tried, some dependent on the various tastes of the insects, others on the well-known proclivity moths have for coming to a light. An ingenious contrivance called the "American Moth Trap," made by Mr. Cooke, of Museum-street, W., operates on the latter principle, and often makes very good bags. Details of this will be given in a future number.

Those moths which fly in the day-time can be caught with the net in the same manner as butterflies, and many nightfliers can be captured in a similar way in broad daylight by beating the hedges with a strong stick, the moths being frightened out of their hiding-places under the leaves by the unusual commotion.

The classification list which I mentioned in last week's paper is too long for these pages at present, but at some future period, when the season's work is nearly finished, we will give it in full, with Mr. Editor's permission. At present we should advise our readers to separate their insects simply into butterflies and moths until the busy time is over, when they can be arranged and named at leisure. The principal and most prominent difference between the two consists in the *antennæ*, or horns, of butterflies being furnished with a knob or club-shaped thickening at the extremity, while in moths this is wanting. There are several other structural differences, but the above is the most easily recognised.

We now give the two diagrams mentioned in last week's paper. Fig. 1 is a setting-board, the shaded portion being cork, with a groove cut down the centre, and the unshaded a wooden backing,

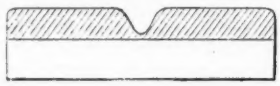


Fig. 1.

preferably pine, to increase the stiffness and strength. The whole should be covered with soft, white paper, as this adds greatly to the appearance, by giving a neat and finished look to the otherwise unsightly board.

Fig. 2 shows an insect set out on one of the above boards. The *modus operandi* is as follows:—First stick a pin through the thorax of the insect, and fix into the centre of the setting-board, with the body in the groove. Then stretch out the wings in the manner shown with a very fine needle, and keep in position with

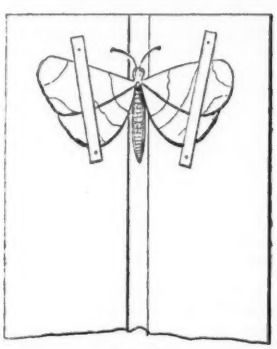


Fig. 2.

strips of cardboard pinned tightly over them. Be careful to set the wings symmetrically, as it adds greatly to the appearance of the insect when in the cabinet or store-box. Practice, however, is the only thing required for this, and the experience gained by setting half-a-dozen moths is worth volumes of description and theory.

Mr. Francis George Heath has accepted the editorship of the *Journal of Forestry*, the new volume of which, just commencing, will give considerable space to all subjects interesting to lovers of the country.

Messrs. Smith, Elder & Co., have announced for immediate publication the first volume of a work on "Human Morphology," by Mr. H. A. Reeves, of the London and other hospitals. The book will consist of seven hundred pages, and will contain five hundred and fifty illustrations, and is likely to become a standard authority in its department. Two other volumes are to follow, and each will contain tables and numerous illustrations. A work on diseases of the breast, by the same author, and containing new views, will also shortly be issued.

XUM

STARS FOR JUNE.

OUR STAR MAP.—The circular boundary of the map represents the horizon. The map shows also the position of the Equator and of that portion of the Zodiac now most favourably situated for observation. The hours are scarcely suited for observation towards the end of the month, but at that time the map for July will be issued, which will be suited for times two hours later. Moreover, it is easy to take into account an hour's motion of the stars, and so to observe on June 21st, at 10 (and so on), when the skies will be sufficiently dark. The names of thirty-nine stars of the first three magnitudes are given below.

On May 30, at 10.30 p.m.
On June 3, at 10.15 p.m.
On June 7, at 10. 0 p.m.
On June 11, at 9.45 p.m.
On June 14, at 9 30 p.m.
On June 18, at 9.15 p.m.
On June 21, at 9. 0 p.m.

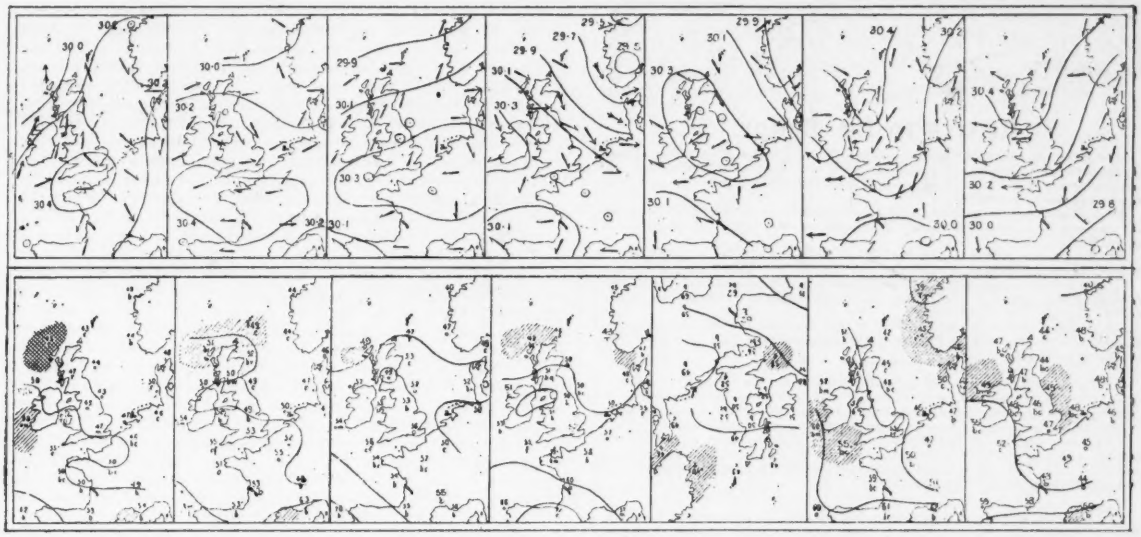
ARABIC NAMES OF STARS.

The following table exhibits the names of all the stars of the first three magnitudes whose names are in common use :—

α Andromedæ	*Alpheratz*
β ———	*Mirach, Mizar*
γ ———	*Almach*
α Aquarii	*Sadalmelik*
β ———	*Sadalsund*
δ ———	*Skat*
α Aquilæ	*Altair*
β ———	*Alshain*
γ ———	*Tarazed*
α Arietis	*Hamal*
β ———	*Sheratan*
γ ———	*Mesartim*
α Aurigæ	*Capella*
β ———	*Menkalinan*
α Boötis	*Arcturus*
β ———	*Nekkar*
ε ———	*Izar, Mizar, Mirach*
η ———	*Muphrid*
α Canum Venat ..	*Cor Corali*
α Canis Majoris	*Sirius*
β ——— ...	*Mirzam*
ε ———	*Adara*
α Canis Minoris ...	*Procyon*
β ———	*Gomeisa*
α^2 Capricorni ...	*Secunda Giedi*
δ ———	*Deneb Algiedi*
α Casiopeiæ ...	*Schedar*
β ———	*Chaph*

Scale of Magnitudes
N.W. Horizon
S.W. Horizon
Equator
Ecliptic
Spica
Azimech
Vindemiatrix
Regulus
Denebola
Algieba
Arcturus
Alphecca
Pollux
Castor
Procyon
Capella
Rigel
Aldebaran
Betelgeux
Sirius
Canopus
Achernar
Fomalhaut
Deneb
Vega
Altair
Antares
Kochab
Polaris
Mizar
Alkaid
Dubhe
Merak
Phecda
Megrez
Alioth
Benetnasch
Alcyone
Algol
Mirfak
Markab
Scheat
Algenib
Enif
Alnilam
Rigel
Bellatrix
Mintaka
Alnilam
Alphard
Zosma
Denebola
Chertan
Ras Algethi
Ras Alhague
Sheliak
Sulaphat
Cebalrai
Rasalgethi
Kornephoros
Unukalhai
Kaus Australis
Nunki
Ancha
Deneb Algiedi
Sadalmelik
Skat
Enif
Homan
Matar
Mirfak
Algol
Alcyone
Atlas
Electra
Maia
Merope
Taygeta
Celæno
Sterope
Asterope
Pleiades
Hyades
Aldebaran
Rigel
Betelgeux
Bellatrix
Alnilam
Mintaka
Sirius
Procyon
Pollux
Castor
Capella
Menkalinan
Alhena
Wasat
Mebsuta
Tejat
Propus
Alhena
Algomeiza
Tejat
Propus
Wasat
Mebsuta
Zaurac
Almaak
Mirach
Alpheratz
Algenib
Markab
Scheat
Enif
Homan
Matar
Mirfak
Algol
Alcyone
Atlas
Electra
Maia
Merope
Taygeta
Celæno
Sterope
Asterope
Pleiades
Hyades
Aldebaran
Rigel
Betelgeux
Bellatrix
Alnilam
Mintaka
Sirius
Procyon
Pollux
Castor
Capella
Menkalinan
Alhena
Wasat
Mebsuta
Tejat
Propus
Algomeiza

WEATHER CHARTS FOR WEEK ENDING MONDAY, MAY 15.



Explanation of Charts.—The two charts for each day show the general condition of the weather over Western Europe at 8 a.m. In the upper chart the height of the barometer is expressed by "isobars," the value of each line being given in figures. The prevalent winds are shown by arrows, which are drawn flying *with the wind*, the force being indicated thus: ⟶⟶ = a heavy gale; ⟶ = a gale; → = a fresh to strong breeze; ⟶ = a light to moderate breeze; and ⊙ = a calm. In the lower chart the weather is indicated as follows:—b = blue sky; c = detached clouds; o = overcast; m = misty (hazy); f = foggy; q = squally; r = rain; h = hail; s = snow; l = lightning; and t = thunder. The general distribution of temperature is shown by "isotherms," and the readings at certain places are given in figures. Diagonal lines = rough sea, the shading being proportional to the disturbance.

The above arrangement has been devised in response to a great number of suggestions. It will, probably, be that which we shall eventually adopt for good; but we may be able, perhaps, hereafter to carry the charts to a later date each week. If so, this will be done without break of continuity.

Notes on Art and Science.

Fire Risks and Electric Lighting.—The Society of Telegraph Engineers and of Electricians have appointed a very influential committee to consider and report upon the rules which they would recommend for adoption for the prevention of fire risks arising from the use of the electric light.

Crystal Palace Exhibition.—As at present arranged, the Electrical Exhibition at the Crystal Palace will close on June 3. Already several exhibitors have begun the work of removing their goods. The Right Hon. the Speaker and a number of Members of both Houses of Parliament, including the Electric Light Committee, will visit the Exhibition on the 27th inst.

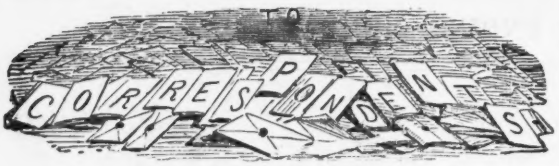
Engineering.—At an extraordinary meeting of the Society of Telegraph Engineers yesterday week (18th inst.), Mr. Stroh repeated his admirable lecture on "Attraction and repulsion due to sonorous vibrations, and comparison of the phenomena with those of magnetism." On the occasion of the first delivery, the *élite* of the world of physical scientists attended, and it is universally admitted that Mr. Stroh, by his marvellously-executed experiments and lucid explanations and deductions, has gone a long way towards demonstrating the nature of magnetism.

Electro-Magnetic Repulsion.—At the Physical Society on Saturday, 13th inst., Professor Guthrie exhibited his modification of Arago's experiment, in which a rotating disc of copper repels a horseshoe magnet suspended vertically above it from the end of a chemical balance beam; a plate of glass being interposed between the disc and magnet to prevent the air from disturbing the results. Professor Guthrie gave a table of observations made on the repulsive force for different speeds of rotation of the disc, and these showed that the repulsive force varies in proportion to the square of the speed of rotation.

Electric Fire-Alarms.—In the annual report of Captain Shaw, chief of the Metropolitan Fire Brigade, it is pointed out that by reason of the system of electric fire-alarms and the excellent telegraphic intercommunication between stations, &c., the various fire-engines and men of the brigade can be concentrated on any given spot in a very much shorter time than was formerly the case. Captain Shaw reports that the electric fire-alarm system has been found to work well, and it is to be greatly extended.

The Recent Magnetic Storm.—The curves given by the Kew magnetograph during the week ending April 22, when auroral displays were so common in America, and earth currents so prevalent in the inland telegraph lines and Indian and Atlantic submarine cables, clearly indicate a severe "magnetic storm" or disturbance of the terrestrial magnetic field. According to Mr. Whipple, the indicating magnets at Kew were somewhat disturbed on April 14, but remained quiescent until the night of the 16th, when they became strongly affected at about 11.45 P.M., and from that time the storm raged until 8 P.M. of the 17th. The maximum reduction in the earth's magnetic force took place at 6 A.M. of the 17th, and a little after noon on the same day both forces became so increased that the registering speck left the field of the receiving instrument for nearly two hours. A second period of disturbance began about 3.40 A.M. of the 20th, which was violent up till about 2 p.m., and gradually diminished in intensity until 7·45 a.m. of the 21st. During this period the magnetic force fluctuated largely, but not to the extent occurring on the 17th. The fact that there were at the time two unusually large spots crossing the sun's disc is certainly in support of the theory that these magnetic storms are associated with sun spots. Mr. Whipple accounts for the abrupt commencement of magnetic storms by the supposition that possibly a sun spot only produces such an effect when cutting certain lines of force, which he imagined might extend for a limited angular distance around the earth's radius sector. It is to be hoped that magnetic observatories will be multiplied, especially in the southern hemisphere, as Professor W. G. Adams has pointed out, and it is satisfactory to learn that the French Government have decided to equip such an observatory at Cape Horn.

XUM



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

All Letters or Queries to the Editor which require attention in the current issue of KNOWLEDGE, *should reach the Publishing Office not later than the Saturday preceding the day of publication.*

(I.) Letters to have a chance of appearing must be concise; they must be drawn up in the form adopted for letters here, so that they may go untouched to the printers; private communications, therefore, as well as queries, or replies to queries (intended to appear as such) should be written on separate leaves.

(II.) Letters which (either because too long, or unsuitable, or dealing with matters which others have discussed, or for any other reason) cannot find place here, will either be briefly referred to in answers to correspondents, or acknowledged in a column reserved for the purpose.

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"There is no harm in making a mistake, but great harm in making none. Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

"God's Orthodoxy is Truth."—*Charles Kingsley.*

Our Correspondence Columns.

THE LATE MR. THOMAS DUNMAN.

[409]—I trust you will find me space to record the inexpressible grief with which I read in this week's KNOWLEDGE of the death, under the most painful circumstances, of Mr. Thomas Dunman. Though personally unacquainted with him, I am sure many who have read his excellent words of wisdom and kindness in the Essays on Life and Duty which he wrote for the "Universal Instructor," will feel with me that they have lost almost a personal friend.

It is difficult to avoid the conclusion indicated by the melancholy example of poor Thomas Dunman, viz., that "science does not pay;" certainly in his case it did not. Often, doubtless, but inadequately remunerated, he laboured to improve an ignorant but unappreciative generation, only to fall an early prey to an over-zealous devotion to them and to science.

I earnestly hope the publicity which you have given to the fact that the bereaved family is unprovided for, will induce many friends to come to their assistance; I shall esteem it a privilege to be allowed to add my contribution, and I feel sure there will be many like myself, who will only await an opportunity to pay a similar tribute to the memory of him who has been so sadly cut off in the flower of a useful and earnest life.

May 19, 1882. J. L. W.

AURORA BOREALIS.

[410]—Aurora Borealis here last night; brilliant from about 11.15 to 11.45; three principal masses of vertical pencillings, like an aerial Staffa, one under Polaris, another about Auriga, a third in Gemini; the limits E. and W. Cassiopeia and Cancer, and altitude about that of the former. Colour not pronounced; pinkish drab, perhaps. This is the only aurora I have seen here in six years, and follows on *the* hottest weather ever known in the second week of May; definition at night magnificent; therm. 64° at midnight a night or two ago. Stiff E. wind.

Pornic, France. HALLYARDS.

TOBACCO AND CONSUMPTION.

[411]—The light that has recently been thrown on the cause and nature of consumption (see Prof. Tyndall's letter) has prompted me to propose tobacco as a preventative and cure for that disease. Some years since, I heard a lecture in New York, by the Turkish Consul for that port, who said consumption was comparatively rare in Turkey. The lecturer claimed that freedom was owing to the peculiar manner in which the Turks inhale the "supreme solace." Your Turkish smoker not only draws the smoke into his mouth but inhales it into the lungs; and it was further stated that the lungs of a Turkish smoker after death were found to be stained a light yellow or buff by the condensed products of the combustion or distillation of the tobacco. The lecturer claimed that these products kept up a constant irritation in the air cells of the lungs, preventing any accumulation of morbid matter. How true all this may be I leave to others better qualified to decide. The importance of the subject makes the slightest facts belonging to it worthy of consideration. It struck me, on reading the late discovery of organic germs of consumption, that not only might the smoke and its constituents act as an irritant on the lungs, but that the condensation and deposition of the empyreumatic oils, &c., might prevent the germs taking root. But a word as to how the Turk smokes. From what I can learn, his shortest "cutty" is fully a yard long (the "tchibouk"), and we all know the construction of the "hookah," and the tempering and purification it exercises on the smoke passing through it. Such smoke, after passing through the long tubes, must lose a great portion of its active and biting properties, and, again, Turkish is not a very pungent variety of the "weed"; so, after all, such a mode of smoking is not so pungent in its effects as it would seem at first sight. Now, don't let these remarks induce any one to try the experiment of taking smoke into the lungs from a short pipe, and using "shag" tobacco, or a violent fit of coughing, and perhaps vertigo, may be the result. If the experiment is tried, let it be with a cigarette or a long-stemmed cherrywood pipe, using the mildest of tobaccos. I have for some time smoked that way myself, and find that the smoke frequently loosens little round globules of mucilaginous phlegm. Some people refuse to believe it is possible to take the smoke entirely into the lungs. They say it gets no farther than the throat, and thence out of nasal passages; but one can draw a good mouthful of smoke, then take a deep breath through the mouth, and speak or repeat the alphabet, and then emit the smoke, proving the smoke to be taken down *into* the lungs. Whether these suggestions are of value I leave to the faculty to determine. If tobacco is really a remedy, I would rather see us a nation of smokers than a nation of consumptives.

W. B. WICKEN.

ENCORES AT CONCERTS.

[412]—It is a little too bad that the best singers at concerts, those with voices best worth careful treating, should be rewarded for their skill and excellence by being called on to repeat their songs. At a charming concert the other day, at the Alexandra Palace, an idea occurred to me about this, which strikes me as being original. Those who use unfairly the right of applauding a singer should be treated by the manager of the concert to repetions (for the sake of practice) by the worst singers; while the singers who perform best should, as a reward, take a rest. Thus, Signor Maas, who, if not phenomenal in vocal qualities, is one of the very sweetest tenors of the day, should have been let off one of his four songs because he gave such perfect satisfaction with the other three. Instead of this, he was asked for more, which is unreasonable and unfair. When there is encore money, the manager of the concert is wronged; where there is not, the singer suffers. M. P.

A MOUNTAIN 3,000 FEET HIGHER THAN EVEREST.

[413]—In a journey through the Island of Papua, made by Capt. J. A. Lawson in 1871, that explorer discovered a mountain, which he named Hercules, the height of which he estimated at at 32,783 ft. above sea level. Has it never been visited or measured by any other explorer? It would seem strange if no expedition had since been sent to verify Lawson's result. E. C. R.

"STUDIES OF VENUS TRANSITS."—Those sheets of the work originally published as "The Universe and the Coming Transits," which relate to the Transits of Venus in 1874 and 1882, are now published by Messrs. Longmans & Co. under the above title. Portions are now necessarily out of date, but all that relates (1) to the transit of Venus in 1882, and (2) to the comparison between the transits of 1882 and 1874, remain as trustworthy now as when originally published in the Monthly Notices of the Royal Astronomical Society. The chart which appeared in the last number but one of KNOWLEDGE, is copied from one of the charts (in two colours) illustrating these studies. Price 5s.

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Answers to Correspondents.

**** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—*1. No questions asking for scientific information can be answered through the post. 2. Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries. 3. Correspondents should write on one side only of the paper, and put drawings on a separate leaf. 4. Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

J. PERKINS. Volume I. ends with number 30. You ask why the price is so high. The answer, I am told, is simply that, to oblige customers, the publishers have disposed of copies of the early numbers and parts (to complete sets) which would otherwise have been available for volumes. Consequently, not one half, or one quarter so many volumes can be bound as they would have wished. To give you an idea how small the stock of volumes, I may mention that from a single colonial bookseller an order for more than one quarter the entire number of volumes then available was received within a few days after the volume had been announced.—R. G. You can readily express a number of many digits, all but the first few being cyphers, in a contracted form by indicating the power of 10 corresponding to the addition of so many digits. Thus instead of 1728183 followed by seventeen digits you may write 1728183×10^{17}.—A READER FROM THE FIRST. Thanks for your suggestion respecting scientific instruments on the three years' system. Will find room for it if possible; but if not, pray consider that our poverty (of space) and not our will declines.—H. H. You are not quite right, but the author of "The Stars and the Sun" is mistaken in that matter. When we see the first rays of the rising sun, we see him in the direction, with reference to the celestial sphere, which he had really occupied eight minutes earlier. The actual effect on the time of apparent rising is not, as you suppose, measured by the time light takes in travelling from the horizon to the eye, or as the author of "Stars and Earth" supposed, the light journey from the sun; but is the time occupied by the horizon plane in shifting through 22″ (the aberration angle) in the direction of the sun's motion on the celestial sphere, and therefore varies with the latitude and time of year.—CORCAGIENSIS. What has appeared about Earth's Population is not Mr. Connall's statement, but mine. It can hardly be said to need confirmation, for the calculation is sufficiently simple and obvious. Nor does it contrast with other statements similarly based on calculation. The present population of the globe could *stand*, I suppose, on five or six square miles. I would like to see actual *proof* that 36,627,843,275,075,845 persons have lived on the earth. Considering that the population of the earth has never probably exceeded 1,800,000,000, that total would imply a very long period during which the earth has been inhabited by man.—F. C. S. Thanks; but, alas, no space. I cannot see myself that the evidence proves the superiority of the boys, but that all work and no play makes Jack a dull boy and Jill a dull girl. I can find space for the extract alone. Your theory of the formation of the earth is not reconcilable with astronomical facts.—JUMBO. Your "banter" is good; I acknowledge with contrition that the stars in my monthly maps do *not* shine with all the brilliancy of stars in the heavens. I must get the printers to use the blackness of night for ink, and sections of the sun's surface for paper. Seriously, you would find it a good plan to punch holes through the map for all the brighter stars, then to paste tissue paper over the back, and hold the map before a good light. The W you speak of (Cassiopeia) can, however, be very well seen, I find, at twice the distance you mention (a yard and a half).—JAS. DEAS. The phenomena observed in cases of so-called "mind reading" are curious, even when cases where there may be deception are eliminated; but where is the evidence of magnetism? Will try, however, to find room for your experience. If not, remember that the reason will simply be want of space.—P. F. D. Thanks.—W. You have not quite correctly written your question; but it means that we are to find the value of the series whose general term is $(-1)^r \frac{\lfloor n+r-1}{\lfloor r-s}$ between the limits $r=s$ and $r=$ infinity.

In this there is no difficulty: making r successively equal to s, $s+1$, $s+2$, &c., we get the series

$$\frac{\lfloor n+s-1}{1} - \frac{\lfloor n+s}{1} + \frac{\lfloor n+s+1}{\lfloor 2} +, \text{ \&c., } ad\ inf.$$

$$= \lfloor n+s-1 \left[1 - \frac{n+s}{1} + \frac{(n+s)\,(n+s+1)}{\lfloor 2} - \text{\&c.} \right]$$

$$= \lfloor n+s-1 \left[(1+1)^{-(n+s)} \right] = \frac{\lfloor n+s+1}{2^{n+s}}$$

J. V. ELIASSON, W. M. WILLIAMS, E. CHAYTOR, and others. It is likely enough that a change from 2d. to 3d. weekly, with certain improvements which you suggest, would find us with a scarcely diminished circulation, and be considered a not unfair charge. But I should myself have strong objections to the change, and I shall do my best to prevent its being tried. So far, indeed, as mere fairness is concerned, such a change in price without any increase in the average expense of KNOWLEDGE, would still, I think, leave readers nothing to complain of; for, of course, the cheapness of KNOWLEDGE must be regarded as an experiment, and (it may be) a risky one, even with the presently constantly growing taste for knowledge. But we have faith and patience, which will, we believe, be justified. Our readers can do a great deal to help us, and to put any change such as you suggest entirely out of the question. If each reader in three obtained but one new reader, or if each in twelve obtained four, the publishers would turn an entirely deaf ear to all suggestions of change of price, and nearly all the suggested improvements would be made at once. As matters go, we look forward to that state of things a little later; and, to resume the first person, readers may rest assured I shall do my best to see that no change of the former kind takes place.

PHOTOGRAPHY.

WISCAP asks for information as to painting photographs on glass in oil or water-colours by a process called "Crystoleum." We never heard of the process. Any one who can paint in oil-colours could apply the process to glass. We doubt the practicability of painting on glass in water-colours.—H. H. The wet collodion process is not the thing of the past you suppose it to be, and, for certain purposes, is not likely to be supplanted by gelatine. Our scheme includes a series of articles on the gelatine dry-plate process. That no dark room is needed while working with gelatine plates is new to us.

ELECTRICAL.

H'SETT. There is a wide difference of opinion as to the origin of earth currents, and accordingly, our ideas concerning them are of the vaguest kind. During the earlier portion of the disturbance you refer to, the currents affected only the wires running N.E. to S.W., but subsequently wires in all directions were affected by currents which doubtless owed their existence to a number of conspiring and conflicting causes. How far the geological structure of the superficial strata affect, by their varying resistance, the passage of earth currents, it is impossible to say, but I should imagine very little indeed. Discarding the earth plate, and substituting a return wire (technically termed a loop), prevents almost entirely currents passing from the earth to the line. This demonstrates that, so far as the wire is concerned, the currents are not induced, but imparted. I heard of no warning being given by our meteorological office to the collieries, of coming magnetic and electric storms; and, in fact, such warnings never have been given by the society. The American Bureau is, however, a little less antiquated, and ventures to predict these storms, and that they may be attended by colliery disasters. One or two men in England are also working on this line.—J. F. R. I really should advise you not to attempt making a machine to support a single Swan lamp. You would find it a comparatively expensive affair. A Swan lamp requires a current of 1·2 ampères (see articles on Generators).—T. SINGTON. Better use small rectangular rods of good metal, and solder the junctions.

ECLECTICUS AND READERS OF KNOWLEDGE GENERALLY.—As soon as we have finished our description of simple forms of electric generators, the subject of "Electrical Units and Simple Methods of Measurement" will occupy our column for the "Amateur Electrician."

BIOLOGICAL.

"G. S." calls attention to what he is pleased to term "a couple of inaacuricies" (*sic*) in a biological note in KNOWLEDGE (page 613) of last week. The first inaccuracy refers to the statement that "with the exception of the Camelidæ, all quadrupeds have round *nucleated* blood-globules." The word "nucleated" should have been rendered *non-nucleated*, the omission of the "non" being a printer's error. We differ from "G. S." both in his spelling of the word "inaccuracies" and in his contention that the word "round" does not describe the blood-globules of mammals. He adds the expression should have been "circular and bi-concave." If "G. S." sees any difference between "round" and "circular" (applied to a blood-globule) he is very welcome to his contention. We did not describe the globule as to its form (bi-concave), since that question was not asked by the inquirer.

By a misprint, "three molars" were said to exist in each jaw of the old world apes as in man. The statement should have read *six molars* in each jaw.

[About two pages of "Answers" have been unavoidably held over.]

XUM

Our Mathematical Column.

SOLUTIONS TO PROBLEMS.

[P. 526]—In a triangle given $a+b$, $a+c$, and angle A, to construct the triangle.

We have received correct solutions to this problem (Knowledge, April 14) from R. F. R., E. N. Dalton, C. E., J. P. Morgan, J. B., Thos. Lyons, and others. The following construction and proof is somewhat simpler than any sent us; Mr. Dalton's is nearest to it, and is in principle the same; but the construction of a species of auxiliary triangle is unnecessary and inelegant.

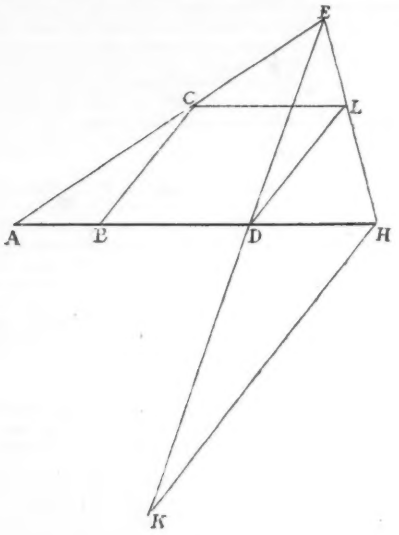


Fig. 1.

Let AD = $a+c$; AE = $a+b$; DAE = angle A and produce AD the less to H, making AH = AE. With centre H, distance HA, describe a circle cutting ED produced in K; draw DL parallel to KH to meet HE, LC parallel to AH, and CB parallel to DL. Then ABC is the required triangle.

For triangle ECL, being similar to EAH, is isosceles; and CLDB is a parallelogram. Now,

DL : KH :: EL : EH :: EC : EA

But KH = AH = EA;
therefore DL = EC = CL = BD
or BC = EC = BD
So that AC + BC = AE = $a+b$
and AB + BC = AD = $a+c$.

[33]—*To bisect a triangle, ABC, by a line drawn from a given point, D, without it.*

The neatest solution we have received of this problem is the following:—

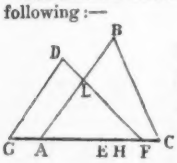


Fig. 2.

Continue out the side AC to meet GD parallel to AB in point G; and bisect the side AC in E. Then make, as GD is to AB so AE to AH. And again, make as GA is to AF so HF to AH; then, if the line DLF be drawn, it will bisect the triangle ABC; *i.e.*, the triangle ALF will be half of the triangle ABC. J. C. Kelly.

[Mr. Kelly does not give the proof, but it is tolerably obvious. Thus, by construction:—

GA : AF :: HF : AH
∴ GF : AF :: AF : AH
$GF^2 : AF^2$ :: GF : AH

Now triangle ABC : triangle GDF :: AC.AB : GF.GD
:: AC.AH : GF.AE

And triangle GDF : triangle ALF :: $GF^2 : AF^2$
:: GF : AH

Wherefore triangle ABC : triangle ALF :: AC : AE
:: 2 : 1 —Ed.]

We have received a neat solution from C. E., and other correct solutions from R. L., Exon, J. P., and others.

[37]—*From a given point to draw two equal straight lines to two given lines, the straight lines thus drawn to include a given angle.*

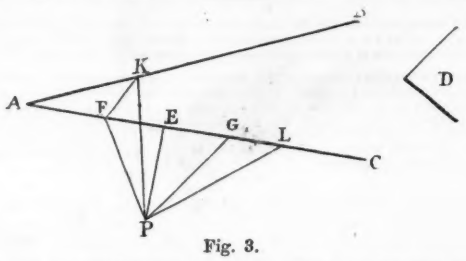


Fig. 3.

The neatest solution sent us is the following:—Let AB, AC, be the two given lines, D the given angle, and P the given point. First let P be outside the angular space BAC. Draw PE perpendicular to AC, and make the angles EPF, EPG each equal half the given angle D. At the point F make the angle PFK equal PGC, and cut off GL equal FK, and join KP, PL. KP, PL are the lines required. Since the triangles PEF, PEG are equal in every respect, PF equal PG. Again PF, FK are respectively equal to PG, GL, and the angle PFK to the angle PGL; therefore, PK is equal to PL, and the angle FPK to the angle GPL; therefore the whole angle FPG is equal to KPL, and FPG is equal to the given angle D.

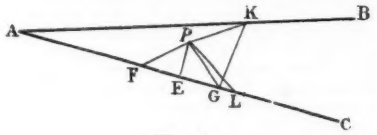


Fig. 4.

Next, let P be within the angular space BAC. Draw the perpendicular PE, and construct the triangles EPF, EPG as before. Make the angle PGK equal PFG, and cut off FL equal GK, and join LP. Because triangles PFL, PGK are equal (Euclid i. 4) in every respect, therefore, PL equal PK, and angle FPL equal GPK. Take away the common angle GPL, therefore angle FPG equal LPK, and FPG is equal to the given angle D.

[D. M. fails to note, however, that there are two solutions to each case. If we make angle PGK′ equal to PFA in the first case, and in CA produced if necessary, make FL′ equal to GK′, then PK′ will equal PL′, and the angle K′PL′ will be equal to D. So in the second case we may make the angle PFK′ equal PGE, and take GL′ (towards A) equal to FK′; then will PK′ equal PL′.—Ed.]

We have received various correct solutions of this problem from T. R., Nemo, H. A. N., E. Whitley, and others.

[38]—Let A be the centre of the disc at which its whole weight may be supposed to be placed, AB the radius of the circum-

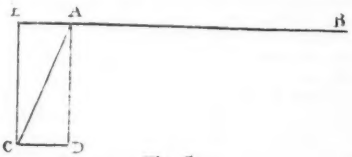


Fig. 5.

ference described by the centre A, AC the radius of the disc, C being in contact with the plane on which the disc rolls. Draw the vertical line AD to the level plane, and complete the parallelogram ED. Let w be the weight of the disc, AC its radius = r, AB = r', AB + CD = R the radius of the track, angle CAD = θ and and vel of A = v.

Then $\frac{w}{g} \times \frac{v^2}{r'} : w :: EA : AD$

$\therefore \frac{v^2}{gr'} = \frac{EA}{AD} = \tan\theta$: hence $r' = \frac{v^2}{g\tan\theta}$

Now $CD = r\sin\theta$. $\therefore R (= CD + AB) = r\sin\theta + \frac{v^2}{g\tan\theta}$

—D. M.

[This solution can only be regarded as approximate; the assumption that the whole weight may be regarded as collected at the centre of gravity being inadmissible in a problem of this sort.—Ed.]

Our Whist Column.

BY "FIVE OF CLUBS."

A GAME FOR STUDY.

WITH reference to this game, *O. P. Q.* makes *Y. Z.* win the odd trick. He hits on the right line of play, but errs in causing *Z.* to discard from weakest and *B.* from strongest suit, though strength in trumps is with *A. B.* G. D. BROWN makes *A. B.* win the odd trick. He causes *Z.* to return his partner's lead of spades, though the only chance for *Y. Z.* lies in *Y.* having strength in Diamonds. T. D. Mackenzie notes that a small club being led, if *B.* finesses the Knave (which he does not approve), *A. B.* will make eleven tricks. Such a finesse in one's partner's suit, and that suit trumps, would be unpardonable. If Ace is played, our correspondent thinks A. B. should make the odd trick. The following is the play in Cavendish :—

THE HANDS.

A.
Clubs—K, 10,9,8,7,6,2.
Spades—K.
Hearts—K, 4.
Diamonds—K, Kn, 9.

Y.
Clubs—Q, 4, 3.
Spades—Kn, 8, 5.
Hearts—A, 5, 2.
Diamonds—A, Q,10,2.

B
Dealer.
Y Z
Trump Card, Club Five.
A

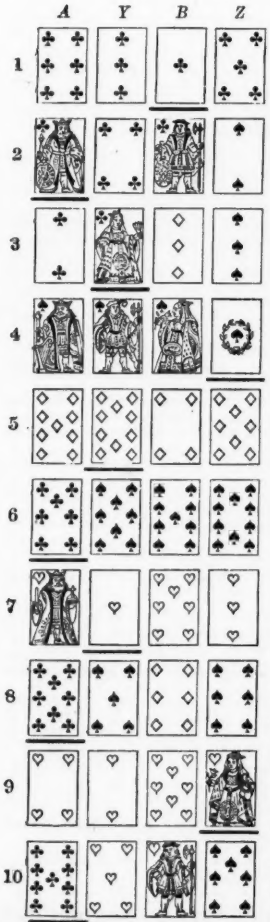
B.
Clubs—A, Kn.
Spades—Q, 9.
Hearts—Kn, 10, 9, 8, 7.
Diamonds—7, 6, 4, 3.

Z.
Clubs—5.
Spades—A, 10, 7, 6, 4, 3, 2.
Hearts—Q, 6, 3.
Diamonds—8, 5.

Score.—*A B*, 3 ; *Y Z*, 4.

THE PLAY.

NOTE.—The underlined card wins trick, and card below it leads next round.



REMARKS AND INFERENCES.

1. *A* leads the penultimate (the ante-penultimate is not *de rigueur* with a six-card suit; but here would have been very suitable).

2. *B* returns the best of two left. *Z* discards from his longest suit, the opponents having shown superior strength in trumps.

3. *A* leads a trump, though thus two fall for one, to show his partner his strength, and that one trick from *B* will win the game. This *Y* and *Z* equally perceive. *Z* sees that nothing can save the game unless *Y* is strong in diamonds (*B*'s discard showing that *B*'s suit must be hearts). *Z* discards another spade, as he must retain the power of leading his partner's suit more than once.

4. *Y* leads his partner's suit. Luckily the honours fall in a single round.

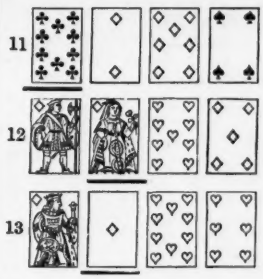
5. *Y* finesses deeply, knowing that, if either King or Knave is with *B*, the game is up anyhow, and

6. Leads his best spade.

7. *A* leads his King, from King one small one—see Leads.

10. *B* discards his best hearts to show he has entire command of the suit.

There can be no doubt, I think, that on both sides the hand is played as good players would be sure to play it. "Cavendish" who considers *A*'s play sound throughout, remarks that *A*'s lead at trick 3 is unlucky, as it puts the adversaries on the only tack for saving the game. But *Y* can count the trumps as it is. He knows *B* cannot have more than one left after second round; and that, if *B* had none, *A* would simply put down the six remaining trumps and claim game. If *A* had not led a trump at trick 3 (which was certainly his proper course), he would have led the small diamond, on which *Y* would have put his ten as the only chance of saving the game. The result would have been the same.



We shall take an early opportunity to exhibit another case, somewhat similar in character.

IT DIDN'T MATTER.—My partner trumps my best card, or does not trump a doubtful card after I have called for trumps, or commits some other Whist enormity. We win the game, notwithstanding, for we have prodigious cards. If I suggest that there was no occasion to perpetrate the enormity in question, my partner triumphantly informs me, "It didn't matter." This view is altogether fallacious. It did not happen to matter in that particular hand, but my confidence is impaired, and it will matter in every hand I play with that partner for a long time to come.—Cavendish's "Card-Table Talk."

Our Chess Column.

VIENNA INTERNATIONAL TOURNAMENT.

The following is the gross score of the players after the finish of the Ninth Round on Saturday night, May 20 :—

Blackburne	7	Steinitz	4½
Mackenzie	7	Wittek	4½
Winawer	7	Weiss	4½
Noa	6	Fleissig	3½
English	5½	Ware	3
Mason	5½	Bird	2½
Zukertort	5½	Meitner	2½
Hruby	4½	Paulsen	2
Schwarz	4½	Tschigorin	2

Mackenzie has up to date not lost a single game, but drawn four. Blackburne, we are glad to remark, is also doing very well indeed. He lost both his first and second games, but since that he has won seven consecutive games. Mason is also doing well, his score being 5½, which is also the total of Zukertort. Mr. Steinitz had again a bad day on Friday last, when he was beaten by Wittek, keeping his score at 4½.

[*By Telegram.*] Vienna, Tuesday night.

Score of English team :—

Blackburne	8	Mason	6½
Mackenzie	8	Zukertort	5½
Steinitz	6½		

Played in the seventh round, May 17th, of the Vienna International Tournament, between Herren W. Steinitz and B. Fleissig.

FRENCH DEFENCE.

WHITE. Steinitz.	BLACK. Fleissig.	WHITE. Steinitz.	BLACK. Fleissig.
1. P to K4	P to K3	21. B to B2	Kt f B4 to K2
2. P to K5(*a*)	P to Q4	22. Q to Kt3	K to Rsq
3. P takes P *en pass.*	B takes P(*b*)	23. Q to R4	K to Ktsq (*i*)
4. P to Q4	Kt to K2	24. Q to Kt3	K to Rsq
5. B to Q3	Kt to Kt3(*c*)	25. Q to R3	Kt to Ktsq
6. Kt to KB3	Kt to B3	26. Q to R5	R to B2
7. Kt to B3	Kt to Kt5(*d*)	27. B to Q2 (*j*)	QKt to B3
8. B to QB4	P to QB3	28. Q to R3	Kt to Q4 (*k*)
9. Kt to K4(*e*)	B to B2	29. P to QB4	QKt to B3
10. Castles	Castles	30. QR to Qsq(*l*)	Q to Ksq(*m*)
11. R to Ksq	Kt to Q4	31. B to B4 (*n*)	R to Bsq(*o*)
12. Kt to B5	Kt to R5	32. Q to R3 (*p*)	B to Kt2
13. Kt to K5	Kt to B4(*f*)	33. Q takes P	B to Rsq
14. P to QB3	B takes Kt	34. Q takes KtP	P to Kt4
15. R takes B	Kt to B3	35. B to Kt 3	Kt to Q2
16. R to Ksq	P to KR3	36. Q to Kt3	P to KB4
17. Q to B3 (*g*)	Kt to Q4	37. P to B3	K to Kt2
18. B to Kt3	P to QKt3(*h*)	38. P to B5(*q*)	QKt to B3
19. Kt to Q3	B to R3	39. Kt to B4	resigns(*r*)
20. Kt to K5	R to Bsq		

NOTES.

(*a*) Not usually played; the object is to confine the Queen's Bishop, and hamper Black's game.

(*b*) Perhaps to be preferred to P takes P, as the two Pawns on the Queen's side would, at a later stage of the game, be subjected to attack.

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(*c*) With a view of eventually playing P to K4.

(*d*) Black was afraid of Castling, on account of the commanding position of White's Bishop, for after Castle's White might at once proceed with P to KR4, Kt to Kt5, P to R5, &c., that is to say, proceed on the basis of attacking the Pawn on R2, of which we indicated the general lines; therefore, Black wished to exchange that Bishop.

(*e*) This again places another piece in a favourable position; should Black play P to KB4, then his King's Pawn becomes weak, because unsupported by another Pawn, and therefore more liable to be captured.

(*f*) All this is merely wrangling for good positions, but Black is wasting time in trying to exchange pieces.

(*g*) This is Mr. Steintz's old style; Black cannot move P to QKt3 now, even if he wished to do so; he suffers from the inconvenience of having his Bishop blocked in.

(*h*) We shall see later on how the Pawn on B3 will fare.

(*i*) Black would be satisfied with a draw.

(*j*) Inch by inch of the ground is won; this is a fine move. He intends at the suitable moment to push on his Queen's Bishop's Pawn and use the Bishop for attacking on the Queen's side *viâ* Kt4.

(*k*) Playing into White's hands; but the difficulty is, what to do? He dare not move the King's Knight, as White would play B takes RP. Had Black played Kt to Q2, White might have responded with Kt to Kt4, threatening the dangerous Kt takes RP, which would yield White a winning attack.

(*l*) White is in no hurry, he goes steady but sure; this move will further aid White as the Black Queen's Bishop's Pawn cannot now be advanced.

(*m*) With the object of avoiding a discovered attack on his Queen, but it cramps his pieces very much.

(*n*) White changes the originally intended move, for if he had played B to Kt4, then Black could advance the Pawn to B4, he having for that purpose played his Queen to King's square. White now threatens to win the exchange by Kt to Kt6(ch).

(*o*) R to K2 was the only other move at his disposal, but White would have different ways of continuing his attack. Black's Rook is brought into awkward play on account of the necessity of defending his QBP, showing plainly how a strong player will take advantage of a very slight weakness even.

(*p*) White pressed on in sometimes almost an imperceptible manner, and now he has gained the desired opportunity. He wins two Pawns and the game, he having by sheer good judgment outmanœuvred his opponent.

(*q*) A fine move. It further tightens his already strong hold. He intends playing his Knight to Q6.

(*r*) Black simply has no good move; he is crushed. If R to Ksq, then B takes BP. Besides B takes P. White also threatens to win by Kt to Q6. If Q to Qsq, then, of course, R takes P.

Played in the seventh round of the Vienna International Tournament, between Herren Zukertort and English, May 17, 1882.

Ruy Lopez.

White. Zukertort.	Black. English.	White. Zukertort.	Black. English.
1. P to K4	P to K4	23. P to QB4	P to KR4 (*i*)
2. Kt to KB3	Kt to QB3	24. Q to Q3	R to B3
3. B to Kt5	Kt to B3	25. Q takes Q	R takes Q
4. Castles	Kt takes P	26. P to B4	P to R5 (*j*)
5. P to Q4	B to K2	27. Kt to B5	P to R6
6. Q to K2	Kt to Q3 (*a*)	28. P to KKt3	R to Ksq
7. B takes Kt	KtP takes B (*b*)	29. Kt to R4	R to Kt5
8. P takes P	Kt to Kt2 (*c*)	30. R to KBsq	Kt to Bsq (*k*)
9. Kt to B3	Kt to B4	31. K to B2 (*l*)	Kt to Q2
10. Kt to Q4 (*d*)	Castles	32. Kt to B3	Kt to B3
11. R to Qsq (*e*)	Q to Ksq	33. Kt to Kt5	R takes Kt
12. Kt to B5	P to B3	34. P takes R	Kt to Kt5ch (*m*)
13. B to R6 (*f*)	Kt to K3	35. K to Ktsq	R takes B
14. Q to Kt4	R to B2	36. P to Kt6	K to Ktsq
15. B to K3	K to Rsq	37. R to B7	R to K8 (ch)
16. Kt takes B	Q takes B	38. R to Bsq	R to K6
17. P takes P	Q takes P	39. R to B7 (*n*)	Kt to K4
18. Q to QR4 (*g*)	Q to Kt3	40. R to K2	R takes P
19. R to Q2	P to B4	41. R takes BP	R to B3 (*o*)
20. Q to Kt3	P to Q3	42. R to K3	B to Kt7
21. Kt to K2	B to Q2 (*h*)	resigned (*p*)	
22. Kt to Kt3	B to B3		

NOTES.

(*a*) We do not at all like this move, but it is the consequence of Black's defence.

(*b*) The Bishop is usually captured with the Queen's Pawn.

(*c*) Looking at the position now, we must again express it as our opinion that Black has not at all obtained a satisfactory defence.

(*d*) To prevent P to Q4, and, in general, to hamper Black's game.

(*e*) Threatening Kt takes P, and taking immediate energetic action.

(*f*) This is very vigorous; if Black takes the B, then Q to Kt4(ch), and on Q interposing, Kt takes B(ch); but the question is, has Black a defence, in which case the B will be forced to retire later on.

(*g*) The object of this move is to attack the weakened Pawns on the Queen's wing; but, of course, he must wait his opportunity, and in the meantime Black might force matters on the King's side.

(*h*) Black is defending himself very well. Should the white Queen play to Kt7, then Black would retire his KR to Bsq, threatening R to Ktsq. We think, therefore, that the flank march of the Queen was ill-advised.

(*i*) Having got his Bishop in the good position on QB3, Black now assumes the offensive himself, forcing the Queen, after her little excursion on the Queen's wing, to return for the better protection of her royal consort.

(*j*) He proceeds undaunted; should White advance the P to B5, then R to Kt5, and after P takes Kt, P takes Kt, P takes P, and R takes P, the White Pawn on K6 will be weak, and eventually fall.

(*k*) Black's manœuvring is very fine; should the White Bishop retire to B2, he would proceed with either Kt to R2, with the intention of playing P to Kt4, or, perhaps better, Kt to K3 attacking the BP, to be followed, on the B again retiring to Ksq, by Kt to Q5, threatening R takes Kt, and then Kt to B6(ch), &c.

(*l*) An effort to extricate his King from the very uncomfortable position, and, at first sight, to be preferred to retiring the B to B2, thereby still further blocking up his King.

(*m*) This is indeed play of the very highest order. Black resisted the Kt to K5 wisely; now he keeps up his attack. K on the K's file cannot be thought of, for after Kt takes B, Black would win the exchange by discovered check.

(*n*) Zukertort would, of course, be quite satisfied with a draw.

(*o*) The winning move.

(*p*) If R to Ksq., Kt to B6 (ch), K to B2., Kt takes R (ch), and White has no resource left. We have no hesitation in saying that Herr English is following closely in the wake of Steinitz, Zukertort, and Blackburne. He is the man of the future.

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